

[Translation from German]

TREATY ON INTERNATIONAL COOPERATION IN THE FIELD OF PATENT AFFAIRS

From the INTERNATIONAL SEARCHING AUTHORITY

To: DTS
St. Anna Str. 15
D-80538 Munich
Germany

PCT

**NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL SEARCH REPORT AND
THE WRITTEN OPINION OF THE
INTERNATIONAL
SEARCHING AUTHORITY, OR THE
DECLARATION**

(Rule 44.1 PCT)

| | |
|--|--|
| Applicant's or agent's file reference 32016.YXS.PC | Date of mailing (day/month/year) 16 August 2005 |
| International application No. PCT/EP2005/003334 | FOR FURTHER ACTION See items 1 and 4 below |
| Applicant YXLON INTERNATIONAL SECURITY GMBH | International filing date (day/month/year) 30 March 2005 |
| <p>1. <input checked="" type="checkbox"/> The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.</p> <p>Filing of amendments and statement under Article 19: The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46): When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report. Where? Directly to the International Bureau of WIPO, 34 chemin des Colombettes CH-1211 Geneva 20, Switzerland, Facsimile No.: +41 22 740 14 35 For more detailed instructions, see the notes on the accompanying sheet.</p> | |

[Balance of form not filled in or translated here.]

**PATENT COOPERATION TREATY
PCT**

INTERNATIONAL SEARCH REPORT
(PCT Article 18 and Rules 43 and 44)

| | | |
|--|--|--|
| Applicant's or agent's file reference 32016.YXS.PC | FOR FURTHER ACTION see Form PCT/ISA/220 as well as, where applicable, item 5 below. | |
| International application No. PCT/EP/2005/003334 | International filing date (day/month/year) 30 March 2005 | (Earliest) Priority Date (day/month/year) 30 March 2004 |
| Applicant YXLON INTERNATIONAL SECURITY GMBH | | |
| <p>This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.</p> <p>This international search report consists of a total of <u>4</u> sheets.</p> <p><input checked="" type="checkbox"/> It is also accompanied by a copy of each prior art document cited in this report.</p> | | |
| <p>1. Basis of the report</p> <p>a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated.</p> <p style="margin-left: 20px;"><input type="checkbox"/> The International Search has been conducted on the basis of a translation of the international application submitted to the Authority 23.1(b))</p> <p style="margin-left: 20px;"><input type="checkbox"/> b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, see Box No. 1.</p> <p><input type="checkbox"/> 2. Certain claims were found unsearchable (see Box II)</p> <p><input type="checkbox"/> 3. Unity of invention is lacking (see Box III)</p> <p>4. With regard to the title,</p> <p><input checked="" type="checkbox"/> the text is approved as submitted by the applicant</p> <p><input type="checkbox"/> the text has been established by this Authority to read as follows:</p> | | |
| <p>5. With regard to the abstract,</p> <p><input checked="" type="checkbox"/> the text is approved as submitted by the applicant</p> <p><input type="checkbox"/> the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority</p> <p>6. With regard to the drawings,</p> <p>a. the figure of the drawings to be published with the abstract is Figure No. <u>1</u></p> <p style="margin-left: 20px;"><input checked="" type="checkbox"/> as suggested by the applicant</p> <p style="margin-left: 20px;"><input type="checkbox"/> as selected by this Authority, because the applicant failed to suggest a figure</p> <p style="margin-left: 20px;"><input type="checkbox"/> as selected by this Authority, because this figure better characterizes the invention</p> <p>b. <input type="checkbox"/> none of the figures is to be published with the abstract</p> | | |

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/EP/2005/003334

| A. CLASSIFICATION OF SUBJECT MATTER According to International Patent Classification (IPC) or to both national classification and IPC IPK 7 H01J35/08 H01J5/18 | | |
|--|---|--|
| B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPK 7 H01J Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic database consulted during international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data, PAJ, INSPEC | | |
| C. DOCUMENTS CONSIDERED TO BE RELEVANT | | |
| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| X | FR 741,148 A (TELLEZ-PLASENCIA) 4 February 1933 (1933-02-04) | 1, 11-15 |
| Y | page 2, line 21 – line 43; Fig. 1 --- | 2-10 |
| Y | DAVID ET AL.: "Liquid metal anode x-ray tube" PROCEEDINGS OF SPIE, Vol. 5196, January 2004 (2004-01), pgs. 432-443, XP002336484 Bellingham page 437 – page 438; Figs. 1, 6; Table 1 --- | 2,5,8,10 |
| Y | DE 199 00 467 A1 (SIEMENS AG) 20 April 2000 (2000-04-20) Col. 1, line 21 – line 25 --- | 3 |
| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex. | | |
| * Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed | | "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family |
| Date of the actual completion of the international search 29 July 2005 | | Date of mailing of the international search report 16 August 2005 |
| Name and mailing address of the ISA European Patent Office PB 5818 Patentlaan 2 NL-2280 Rijswijk | | Authorized officer J. Krauss |

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/EP2005/003334

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|--|-----------------------|
| Y | WO 03/077277 A (KONINKLIJKE PHILIPS ELECTRONICS N.V; PHILIPS INTELLECTUAL PROPERTY & S) 18 September 2003 (2003-09-18) page 15, line 5 – line 9; Figs. 6, 7 --- | 4, 6, 7 |
| Y | US 5,105,456 A (RAND ET AL) 14 April 1992 (1992-04-14) Col. 3, line 15 --- | 9 |
| Y | LI PING-WEI ET AL.: "Applications of Polycapillary X-ray Optics in Protein Crystallography" JOURNAL OF APPLIED CRYSTALLOGRAPHY, Vol. 31, October 1998 (1998-10), pgs. 806-811, XP009051447, Denmark, pg. 807, left col., lines 1-10 --- | |
| A | EP 0,584,871 B (DR. DAGANG TAN) 20 November 1996 (1996-11-20) Abstract page 2, lines 19-29; Claim 1 --- | 1-15 |
| A | US 6,560,313 B1 (GEOFFREY HARDING ET AL) 6 May 2003 (2003-05-06) --- | |
| A | EP 0,425,718 A (SIEMENS AKTIENGESELLSCHAFT) 8 May 1991 (1991-05-08) --- | |
| A | DE 10,147,473 A1 (SIEMENS AG) 10 April 2003 (2003-04-10) --- | |

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/EP/2005/003334

| Patent document listed in the search report | | Date of publication | Member(s) of patent family | Date of publication |
|--|----|---------------------|----------------------------|---------------------|
| FR 741148 | A | 04-02-1933 | DE 616288 C | 24-07-1935 |
| DE 19900467 | A1 | 20-04-2000 | KEINE | |
| WO 03077277 | A | 18-09-2003 | AU 2003207882 A1 | 22-09-2003 |
| | | | EP 1485935 A1 | 15-12-2004 |
| | | | WO 03077277 A1 | 18-09-2003 |
| US 5105456 | A | 14-04-1992 | US 4993055 A | 12-02-1991 |
| | | | EP 0473852 A1 | 11-03-1992 |
| EP 0584871 | B | 02-03-1994 | DE 4228559 A1 | 03-03-1994 |
| | | | DE 59304524 D1 | 02-01-1997 |
| | | | EP 0584871 A1 | 02-03-1994 |
| | | | JP 6162972 A | 10-06-1994 |
| US 6560313 | B1 | 06-05-2003 | DE 19955392 A1 | 23-05-2001 |
| | | | EP 1102302 A1 | 23-05-2001 |
| | | | JP 2001155670 A | 08-06-2001 |
| EP 0425718 | A | 08-05-1991 | EP 0425718 A1 | 08-05-1991 |
| | | | DE 58908218 D1 | 22-09-1994 |
| | | | US 5052034 A | 24-09-1991 |
| DE 10147473 | A1 | 10-04-2003 | US 2003058995 A1 | 27-03-2003 |

[KEINE] = NONE

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

| | | | |
|---|--|--|--|
| To: See Form PCT/ISA/220 | | PCT WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (PCT Rule 43 <i>bis</i> .1) | |
| Applicant's or agent's file reference See form PCT/ISA/220 | | FOR FURTHER ACTION See paragraph 2 below | |
| International application No. PCT/EP2005/003334 | International filing date (<i>day/month/year</i>) 30 March 2005 | Priority date (<i>day/month/year</i>) 30 March 2004 | |
| International Patent Classification (IPC) or both national classification and IPC H01J35/08, H01J5/18 | | | |
| Applicant YXLON INTERNATIONAL SECURITY GMBH | | | |
| <p>1. This opinion contains indications relating to the following items:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Box No. I Basis of the opinion <ul style="list-style-type: none"> Box No. II Priority Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability Box No. IV Lack of unity of invention <input checked="" type="checkbox"/> Box No. V Reasoned statement under Rule 43<i>bis</i>.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement <input checked="" type="checkbox"/> Box No. VI Certain documents cited <input checked="" type="checkbox"/> Box No. VII Certain defects in the international application <input checked="" type="checkbox"/> Box No. VIII Certain observations on the international application <p>2. FURTHER ACTION</p> <p style="padding-left: 20px;">If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1<i>bis</i>(b) that written opinions of this International Searching Authority will not be so considered. If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later. For further options, see Form PCT/ISA/220.</p> <p>3. For further details, see notes to Form PCT/ISA/220.</p> | | | |
| Name and mailing address of the ISA/ European Patent Office D-80298 Munich | | Authorized officer J. Krauss | |

[Balance of form not filled in and thus not translated]

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty Yes: Claims 2-9, 10
 No: Claims 1, 11-15

Inventive step Yes: Claims --
 No: Claims 1-15

Industrial applicability Yes: Claims 1-15
 No: Claims

2. Citations and explanations:

see Annex

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see Annex

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see Annex

Concerning Point V

Founded determination regarding novelty, inventive activity and industrial applicability; documents and explanations in support of this determination

Reference is made to the following documents:

- D1: FR 741,148 A (TELLEZ-PLASENCIA) 4 February 1933
- D2: DAVID ET AL.: "Liquid metal anode x-ray tube" PROCEEDINGS OF SPIE, Vol. 5196, January 2004, pages 432-443, Bellingham, XP002336484
- D3: DE 199 00 467 A1 (SIEMENS AG) 20 April 2000
- D4: WO 03/077277 A (KONINKLIJKE PHILIPS ELECTRONICS N.V; PHILIPS INTELLECTUAL PROPERTY & S) 18 September 2003
- D5: US-A-5,105,456 (RAND ET AL) 14 April 1992
- D6: LI PING-WEI ET AL.: "Applications of Polycapillary X-ray Optics in Protein Crystallography," JOURNAL OF APPLIED CRYSTALLOGRAPHY, Vol. 31, October 1998, pages 806-811, Denmark, XP009051447
- D7: EP-B-0,584,871 (DR. DAGANG TAN) 20 November 1996

V1 Comments:

- V1.1 **Claim 1** defines the **exit angle** between the incident electron beam and the exiting X-rays. Since these are diverging rays (cf. Description, p. 6, line 24), this angle must be understood as the angle between the electron beam and (any) one of the X-rays.

- V1.2 Only in **Claim 10** is the yz **plane** (and hence the x axis) defined (in particular, however, not the y and the z **axis** itself, so that these axes must be understood as any axes within the yz plane and the xz plane likewise must be understood as any plane containing the x axis.

Claims 11 - 14, in which the y/z **axis** and/or the xz/xz **plane** is used for definition of the scope of protection, refer however to all of the claims preceding them and not solely to Claim 10, so that the axes and planes in these claims must be understood as **any** axes and planes.

V1.3 The formulations “**width**” and “**height**” of the X-ray in **Claim 14** are not clear, but on the basis of the description are understood for the following examination in the sense of semiaxes of an elliptical section of the X-ray beam with a corresponding plane.

V2 **Novelty:**

V2.1 As this is to be understood, the subject matter of **Claim 1** is **not novel** within the meaning of Article 33 (2) PCT, so that the requirements of Article 33 (1) PCT are not met.

Document D1 discloses (the references in parentheses refer to this document):
An anode module for a liquid metal anode X-ray source (p. 1, lines 26-33), which in the focus region has an electron entrance window (the wall 2, Fig. 1, p. 1, line 49),
wherein an x-ray exit window (implicitly) lies opposite the electron entrance window (Fig. 1, p. 2, lines 27-34)
and the exit angle of the x-rays between an electron beam entering through the electron entrance window along the direction of incidence and the X-rays exiting through the x-ray exit window is between 5° and 50°, in particular 15°, (owing to emission in a solid angle, which comprises almost a hemisphere - p. 2, lines 40-42 - an angle of 5°-50° and in particular an angle of 15° is disclosed, cf. Comment V1.1).

V2.1 **D1** further discloses the subject matter of the **dependent claims 11-15** as these are understood, which thus is **not novel**, in detail:

Claims 11-13:

the angle of incidence between the direction of incidence of the electron beam and the z axis is between 5° and 65°, preferably 50°;

the anode angle between the direction of exit of the X-ray beam and the y axis is between 10° and 50°, preferably 20°;

the angle of incidence, the anode angle and the angle of exit all lie in the yz plane:

Since the axes and planes, which are referred to in the claims for definition, must be understood as any axes and planes (cf. Comment V1.2 above), the subject matter of these claims is likewise disclosed by D1.

Claim 14:

the ratio between the width of the x-ray and the height of the x-ray in the xz plane is between 2 and 6, preferably 4:

Since the xz plane, which is referred to for definition, must be understood as any plane (cf. Comment V1.2 above), the subject matter of these claims is likewise disclosed by D1, since the sectional area between a plane tilted opposite the direction of exit of the x-ray beam assumes an arbitrary elliptical shape depending upon position (cf. Comment V1.3 above).

Claim 15:

X-ray emitter (title) with an electron source for the emission of electrons (cathode 4 in Fig. 1) and a liquid metal anode emitting X-rays upon striking of the electrons, which has an anode module according to the instant Claim 1 (cf. arguments concerning Claim 1).

V3 **Inventive Activity:**

The present application does not meet the requirements of Article 33 (1) PCT, because the subject matter of Claims 2-8, 10 is not based upon inventive activity within the meaning of Article 33 (3):

The subject matter of Claims 2-8, 10, as these are understood, refers to dimensions and configurations of individual regions of the liquid metal anode. These all lie in ranges known per se for liquid metal anodes and/or X-ray sources. The concrete selection of these parameters thus lies in the area of common practice of a person skilled in the art for optimizing the anode module in D1 for a concrete application, perhaps with regard to a desired radiation energy, for which D1 gives detailed considerations.

In detail:

Claim 2:

Electron exit window is a tungsten film with a thickness of 13 μm (**D2**, p. 434, Table 1)

Claim 3:

the X-ray exit window is a steel plate with a thickness of 200 μm (**D3**, column 1, lines 21-25)

Claim 4:

anode module has in the focus region a thickness in the direction of the incident electron beam of 250 μm (**D4**, p. 15, line 7)

Claim 5:

anode module has in the focus region a constricting channel in the direction of the incident electron beam (**D2**, Fig. 1) and outside the focus region a thickness of 10 mm (**D2**, p. 437)

Claim 6:

the electron entrance window is bent convex perpendicular to the direction of flow of the liquid metal (**D4**, Fig. 6)

Claim 7:

the X-ray exit window is bent concave perpendicular to the direction of flow of the liquid metal (**D4**, Fig. 7)

Claim 8:

the focus length is 6 mm (**D2**, Fig. 4)

Claim 9:

effective focus size of 1 mm x 1.3 mm: the known values of effective focus size vary greatly depending upon the purpose for which the X-ray system is used (**D5**, (column 3, lines 14-15) discloses an effective focus size of 1 mm x 1 mm, **D6** (p. 807, lines 1-10 of the left-hand column) of 0.3 x 3 mm); one skilled in the art will thus adapt this value to the desired conditions of use, so selection of the concrete value of 1 mm x 1.3 mm involves no inventive activity.

Claim 10:

the focus region runs parallel to the YZ plane, which is perpendicular to the direction of flow of the liquid metal (**D2**, Fig. 6)

V4 Comment:

D7 discloses an x-ray tube with transmission anode, where the angle between the direction of incidence of the electrons and the direction of the central ray of the useful X-ray beam emitted through the carrier layer is between 10° and 40° (**D7**, Claim 1), in order thus to convert more of the electric energy used into useful X-radiation (**D7**, p. 2, lines 19-29).

D7 further mentions the **problem** of opposing requirements regarding the thickness of the anode in transmission tubes in order on the one hand to weaken the exiting X-rays as little as possible, and on the other hand to ensure removal of the thermal energy produced (**D7**, p. 2, lines 10-12) and in addition stresses the transferability to a variety of tubes for a variety of applications (**D7**, p. 3, lines 6-17).

Starting out from this problem of removal of heat, one skilled in the art, in order to further increase the thermal capacity of the anode, would **combine** the disclosure of **D7** with the disclosure of **D1**, and so by use of a liquid metal anode according to D1 instead of a rotary or stationary anode (D1, p. 1, lines 1-37) to further increase heat removal of the anode.

Concerning Point VII

Specific deficiencies of the international application

- VII1 The claims on the one hand refer to “X-rays” (Claims 1, 15), on the other hand, to an “X-ray” (Claims 12, 14).
- VII2 All claims refer to an electron **entrance** window and an incident electron beam, with the exception of Claim 2, which no doubt inadvertently mentions an electron beam **exit** window.

Concerning Point VIII

Specific comments concerning the international application (Article 6 PCT)

- VIII1 One cannot tell clearly from the wording of Claim 1 whether the exit angle is measured as the angle between the electron beam oriented to the anode and the X-ray (“reflection”), or as the angle between the prolongation of the electron beam beyond the anode and the X-ray (“transmission”). **Claim 1 is thus unclear.**
- VIII2 **Claim 1 is in addition unclear**, since the exit angle between the incident electron beam and the exiting, diverging X-rays is defined [*sic*] (cf. Comment V1.1).
- VIII3 **Claims 11 - 14** are unclear, since the axes and planes in these claims are not defined (cf. Comment V1.2).

- VIII4 The formulations “width” and “height” of the X-ray in **Claim 14 are not clear** (cf. Comment V1.3).
- VIII5 The meaning of “thickness” of the anode module in **Claim 4 is unclear**, since on the one hand, the electron entrance window and the X-ray exit window are defined as part of the anode module (cf. Claim 1), but the thickness of the anode module is smaller than the sum of the thicknesses of the windows as they are defined in Claims 2 and 3.
- VIII6 The meaning of the terms “convex” and “concave” in **Claims 6 and 7 is unclear**. They refer to a window and hence to a surface, but these terms are defined only in connection with physical bodies. Thus, for example, the surface of a cylinder is convex.